

Authorized *floodlighting* will be measured for payment by the day. A day is defined as the period of time included in one continuous period of darkness. Each day of floodlighting will include the cost of furnishing, installing, maintaining, and servicing the lights, including the electric current required and any other additional costs incurred for concrete placement at night. Consider floodlighting authorized for the same period the Engineer requires nighttime concrete placement in writing.

Concrete rail, parapet or metal handrail with concrete posts will be measured by the linear foot (meter) from outside to outside of end posts with no deduction for expansion joint gaps. *Metal posts* will be measured by the linear foot (meter) from end to end of railing in place.

Unless otherwise provided, incidental items will be paid for as provided under the following sections:

Metal Drains	506
Reinforcing Steel for Structures	511

504.06. BASIS OF PAYMENT.

The accepted quantities, measured as specified in this Section, will be paid at the contract price per unit of measurement for the pay items listed below that are shown in the Plan bid schedule. Payment will be full compensation for the respective work prescribed in this Section. Payment will be made under:

- (A) APPROACH SLAB SQUARE YARD(SQUARE METER)
- (B) SAW-CUT GROOVING SQUARE YARD (SQUARE METER)
- (C) EXPANSION JOINTS LINEAR FOOT (METER)
- (D) FLOODLIGHTING DAY
- (E) CONCRETE RAIL LINEAR FOOT (METER)
- (F) CONCRETE PARAPET LINEAR FOOT (METER)
- (G) HANDRAILING LINEAR FOOT (METER)
- (H) RAPID CURE JOINT SEALANT LINEAR FOOT (METER)
- (I) ELASTOMERIC MORTAR CUBIC FOOT (CUBIC METER)

SECTION 505

REPAIR AND OVERLAY OF CONCRETE BRIDGE DECKS

505.01. DESCRIPTION.

- (a) **Repair.** Repair of bridge decks consists of removing loose, delaminated, spalled, or deteriorated concrete from the existing surface, replacing with new high density concrete, or latex modified concrete and other necessary work as specified in the contract documents. When the bridge deck is to be overlaid, the replacement material for Class A and Class B repair shall be the same as the overlay material.

The Engineer will make a field inspection of all bridge decks and determine the areas of concrete deck to be repaired. These areas will be marked by the Engineer and repaired by the Contractor. The lower limit for Class A and Class B bridge deck repair shall be to suitable

existing concrete, as determined by the Engineer. Bridge deck repair shall be classified as follows:

1. *Class A Bridge Deck Repair.* Class A bridge deck repair consists of:
 - Removing unsound concrete down to the top mat of reinforcing steel;
 - Disposing of concrete removed;
 - Replacing the excavated volume of concrete with high density concrete or latex modified concrete.
 2. *Class B Bridge Deck Repair.* Class B bridge deck repair consists of:
 - Removing unsound concrete below the top mat of reinforcing steel;
 - Cleaning existing concrete from the top mat of reinforcing steel in the repair area;
 - Disposing of concrete removed;
 - Replacing the excavated volume of concrete with high density concrete or latex modified concrete.
 3. *Class C Bridge Deck Repair.* Class C bridge deck repair consists of:
 - Removing all unsound concrete for the full depth of the deck;
 - Cleaning existing concrete from both mats of reinforcing steel in the repair area;
 - Disposing of concrete removed;
 - Replacing the excavated volume of concrete with Class AA concrete.
- (b) **Overlays.** Overlay of bridge decks consists of deck preparation and overlaying with either high density concrete or latex modified concrete, and other necessary work as specified in the contract documents. Unless otherwise specified, the overlay shall raise the roadway surface and shall cover the entire concrete deck. Deck preparation and overlaying consist of:
- Sandblasting and/or chipping the concrete to a depth as necessary to remove rust, oil, and other foreign matter leaving a clean etched concrete surface free of any laitance; (Where the original deck concrete was cured by linseed oil emulsion, the entire deck shall be scarified to a depth of $\frac{1}{4}$ inch (6mm) below the original surface.)
 - Disposing of concrete removed;
 - Overlaying with the specified overlay concrete to the depth designated in the contract documents.

Thickness of the concrete overlay shall be measured from the level of the original surface to the specified final raised surface as shown on the Plans. When the deck is to receive Class A or Class B repairs, the replacement material may be placed monolithically with the overlay course or separately prior to the overlay.

505.02. MATERIALS.

Use materials conforming to the following subsections:

High Density Concrete	701.10
Latex Modified Concrete	701.11

For repairs and overlays, use either high density concrete or latex modified concrete as specified in the contract documents. Limit the maximum concrete temperature to 85°F (30°C).

505.03. EQUIPMENT.

Provide all equipment with suitable traps, filters, drip-pans, or other devices to prevent oil or other deleterious matter from being deposited on the deck.

(a) **Surface Preparation Equipment.** Use the following types of surface preparation equipment:

1. *Sawing Equipment.* Use sawing equipment capable of sawing concrete to the specified depth.
2. *Sandblasting Equipment.* Use sandblasting equipment capable of removing rust and old concrete from the exposed reinforcement.
3. *Power Driven Hand Tools.* Power driven hand tools for removal of concrete will be permitted with the following restrictions:
 - Limit the nominal size class of jack hammers to a maximum of 30 pounds (125N).
 - Operate jack hammers or mechanical chipping tools at an angle less than 45° measured from the surface of the slab.
 - For removing concrete from beneath any reinforcing bar, limit the nominal size class of chipping hammers to a maximum of 15 pounds (65N).
4. *Scarifying equipment.* Use a scarifier for preparing an existing deck for an overlay. Use a power-operated mechanical scarifier capable of uniformly scarifying or removing the old surface to the depths required.

(b) **Proportioning and Mixing Equipment.**

1. *For High Density Concrete.* Use proportioning and mixing equipment meeting the requirements of Subsection 414.03 for high density concrete. Use a construction or stationary concrete mixer of the rotating-paddle type, or a continuous mixer used in conjunction with volumetric proportioning.
2. *For Latex Modified Concrete.* Use proportioning and mixing equipment of a self-contained, mobile, continuous-mixing type meeting the following requirements:
 - The mixer shall be self-propelled and shall be capable of carrying sufficient unmixed, dry, bulk cement, sand, coarse aggregate, latex modifier, and water to produce on the site not less than 5 cubic yards (5m³) of concrete.
 - The mixer shall be capable of positive measurement of cement being introduced into the mix. The recording meter visible at all times and equipped with a ticket printout shall indicate this quantity.
 - The mixer shall provide positive control of the flow of water and latex emulsion into the mixing chamber. Water flow shall be indicated by a flowmeter and shall be readily adjustable to provide for minor variations in aggregate moisture.
 - The mixer shall be capable of being calibrated to automatically proportion and blend all components of indicated composition on a continuous or intermittent basis as required by the finishing operation, and shall discharge mixed material through a conventional chute directly in front of the finishing machine. Sufficient mixing capacity of mixers shall be provided to permit the intended placement of the mixed material without interruption.

(c) **Placing and Finishing Equipment.**

1. *Placing Equipment.* For placing and rough finishing, use adequate hand tools for placement of stiff plastic concrete to approximately the strike off level of the screed.
2. *Finishing Machines.*
 - *Repairs.* For deck repairs, use a vibrating screed to finish the deck surface.
 - *Overlays.* Place and finish overlays with an approved finishing machine meeting the following requirements.

Use a finishing machine capable of screeding concrete within 12 inches (300mm) of the face of the existing curb or parapet wall. Make the screed sufficiently long to extend at least 6 inches (150mm) beyond the sides of the placement section, overlapping previously placed courses, overlay forms, and existing and planned sawcut edges. Provide each screed with positive control of the vertical position, the angle of tilt, and the shape of the crown.

Power and gear the finishing machine to maintain smooth finishing operations under all conditions in forward and reverse. Make provisions for raising the screeds to clear the screeded surface for traveling in reverse.

Use a finishing machine capable of final screeding within 10 minutes of depositing the concrete on the deck under normal operating conditions. See Table 505-1 for other production rate requirements.

Support the finishing machine on rails that are fully adjustable, not shimmed, to obtain the correct profile.

When placing concrete in a lane abutting a previously completed lane, equip the finishing machine to travel on the completed lane without marring or damaging its surface.

For high density concrete overlays, use a mechanical strike-off to provide a uniform thickness of concrete in front of the oscillating screed. Equip the oscillating screed(s) to consolidate the concrete to 98% of the unit weight determined by AASHTO T 121. Install identical vibrators along the screed length on 5 foot (1.5m) maximum centers. Make the bottom face of this screed at least 5 inches (125mm) wide with a turned up or rounded leading edge to minimize tearing of the surface of the plastic high density concrete.

For latex modified overlays, use a finishing machine equipped with not less than two finishing devices:

- A vibrating screed designed to consolidate the modified composition to 98% of the rodded unit weight, and one of the following,
- A vibrating oscillating screed, or
- A finishing device consisting of one or more rotating cylindrical drums not exceeding 4 feet (1.2m) in length.

Equip the vibrating screed(s) for latex modified concrete with positive control of vibration so that vibration frequency can be varied between 3000 and 6000 vibrations per minute. Make the bottom face of the screed at least 4 inches (100mm) wide.

505.04. CONSTRUCTION METHODS.

- (a) **General.** Comply the requirements of Section 509 unless otherwise specified.
- (b) **Work Plan.** Before starting the work, submit a work plan to the Engineer and obtain approval. Allow 14 days for the Engineer's review. Include descriptions of the material, equipment, and forms to be used, and the labor requirements.

For overlays, show that the proposed labor and equipment for proportioning, mixing, placing, and finishing new concrete can meet the production requirements of Table 505-1.

Table 505-1
Overlay Production Rates

Total Overlay Area per Bridge, per Bridgesquare yards (m²)	Minimum Production Rate, Cub.Yd./hr. (m³/hr.)
0-298 (0-249)	1.0 (0.75)
299-477 (250-399)	1.5 (1.15)
478-658 (400-550)	2.0 (1.50)
More than 658 (More than 550)	2.5 (1.90)

(c) **Preparation of Surfaces.**

1. *General Requirement for Repairs.* Remove all unsound deck concrete as specified. Repair areas will be enlarged, reduced, or reclassified as directed by the Engineer, based upon inspection. Do not revise the size of a repair area without permission.

Provide a saw-cut vertical edge around the perimeter of the repair areas. Make the saw cut at least 1 inch (25mm) deep measured from the original surface of the deck.

Avoid cutting, stretching, or damaging any exposed reinforcing steel. Blast clean reinforcing steel to remove all concrete. Replace damaged reinforcing steel, lapping new and old reinforcing as directed.

After removing all unsound concrete, clean and dry the repair area using sandblasting and filtered air blast. Remove all rust, oil, and other foreign matter to provide a clean, dry, etched concrete surface.

2. *Class A Bridge Deck Repair.* For Class A repair, remove unsound concrete by chipping with power hand tools specified in 505.03. In Class A repair areas, notify the Engineer before removal below the top mat. Where removal of material beneath the top mat of reinforcing steel is directed, the repair will be classified as Class B repair.
3. *Class B Bridge Deck Repair.* For most Class B repair, remove unsound concrete by the methods used for Class A repair. If removing unsound concrete deeper than 50% of the original deck thickness, use 15 pound (65N) chipping hammers or hand tools to prevent damage to remaining concrete. In Class B repair areas, notify the Engineer before removing concrete below the mid-depth level. Remove concrete at least 1 inch (25mm) below the top mat. If the depth of the bottom mat is reached, remove the full depth of the deck. Full depth removal will be classified as Class C repair.

4. *Class C Bridge Deck Repair.* For Class C repair, remove the concrete for full depth of the deck, leaving the reinforcing steel intact.

Provide forms meeting the requirements of Section 502 to enable placement of new concrete in the full-depth opening. For areas of one square yard or greater, support forms from the existing superstructure. For smaller areas, the forms may be suspended from existing reinforcing bars by wire ties. Remove all forms when completed. Show typical forming details in the work plan submittal.

5. *Overlays.* Clean the entire existing concrete deck area uniformly using sandblasting alone or chipping followed by sandblasting. Sandblast that portion of the curb or parapet wall against which new concrete is to be placed. Remove all rust, oil, and other foreign matter to provide a clean, etched concrete surface free of laitance. If the original deck concrete was cured with linseed oil emulsion, scarify to a depth of $\frac{1}{4}$ inch (6mm) below the original deck before cleaning.

Place expansion joints as shown on the contract drawings. The longitudinal and transverse profile and the elevation of all expansion joints will be established by the Engineer.

(d) **Mixing.**

1. *High Density Concrete.* Mix high density concrete at the project site in accordance with Section 414.
2. *Latex Modified Concrete.* Comply with the following requirements for the proportioning and mixing latex modified concrete materials:
 - *Measurement of Materials.* Accurately proportion all materials for the specified mixture using a mobile continuous mixer. Calibrate the proportioning equipment for each material in the presence of the inspector. Operate the proportioning equipment at the manufacturer recommended speed during calibration, checks, and normal operation. Make yield checks as needed.
 - *Mixing of Materials.* Mix materials in accordance with the specified requirements for the equipment used. The mixture, as discharged from the mixer, shall be uniform in composition and consistency. Mixing capability shall be such that finishing operations can proceed at a steady pace with final finishing completed before the formation of the plastic surface film.
3. *Class AA Concrete.* Comply with Section 414.

(e) **Placing and Finishing Concrete for Repairs.**

1. *General.* Concrete for repairs may be placed either monolithically with overlays or separately. In addition to the surface screed vibration, vibrate the fresh concrete internally if the concrete thickness is 3 inches (75mm) or more.

If to be overlaid, leave the repair rough textured. If not to be overlaid, match the surface texture of the repair with the existing deck. Unless part of an overlay, place concrete to the level to the existing deck.
2. *Surface Preparation Immediately before Concreting.*
 - *Grouting for High Density Concrete.* Before placing high density concrete, scrub a thin coating of bonding grout into the dry, prepared surface. Exercise care to insure

that all parts receive a thorough, even coating and excessive grout does not collect in pockets. Limit the application rate of grout to insure the grout does not dry before concrete placement. Since grout will dry on a vertical surface more rapidly than the flat deck surface, give special attention to maintaining the grout in the required condition.

- *Surface Wetting for Latex Modified Concrete.* Before placing latex modified concrete, clean the repair areas with air blast followed by flushing with water. Keep the surfaces wet for an hour or more before placing latex modified concrete. Remove puddles of free water before concrete placement.

(f) **Placing and Finishing Concrete for Overlays.**

1. *Dimensions.* Make high density overlays 2 inches (50mm) $\pm 1/4$ inch (6mm) thick and latex modified overlays $1\frac{1}{2}$ inches (38mm) $\pm 1/4$ inch (6mm) thick. Limit the width of each overlay pass to a maximum of 26 feet (8m).
2. *Joints.*
 - *High Density Concrete.* Saw the previously placed high density concrete overlay course to have straight and vertical edges at transverse and longitudinal joints, before placing the adjacent overlay course. Remove all slurry produced by wet sawing of concrete joints from prepared areas before placing new concrete.
 - *Latex Modified Concrete.* Install transverse bulkheads, equal in depth to the thickness of the latex modified concrete, to the required grade and profile before placing concrete.
3. *Finishing Machine Setup.* Adjust the finishing machine to provide the required overlay profile. Place finishing machine rails outside the area to be concreted. Positively anchor the rails to provide horizontal and vertical stability for the rails. Do not use a hold-down device shot into the concrete unless the concrete is to be subsequently resurfaced. Submit working drawings for anchoring support rails for approval.

Before concrete is placed, make a dry run with the finishing machine to check anticipated overlay thickness. Attach a filler block having a thickness $1/8$ inch (3mm) less than overlay thickness to the bottom of the screed. With screed guides in place, pass the screed over the area to be concreted. Correct, in an approved manner, those areas not having the required clearance.

4. *Surface Preparation Immediately before Concreting.* Prepare the surface to be overlaid in the manner specified for repairs using like concrete type (refer to Subsection 505.04(e)2).
5. *Placement.* Place concrete in a continuous operation throughout the pour. In case of a long delay in latex modified concrete placement, install a transverse bulkhead. During shorter delays of less than one hour, protect the end of the placement from drying with several layers of wet burlap.

Place and mechanically strike off the new concrete overlay slightly above the final grade. Mechanically consolidate to 98% of the unit weight, determined by AASHTO T 121, and screed to final grade. In addition to the surface screed vibration, vibrate fresh concrete internally if 3 inches (75mm) or more in thickness. Hand finish with a wood float as required to produce a tight, uniform surface.

6. *Work Bridges.* Keep a minimum of two movable work bridges on hand at all times during concrete placement. Use one of the work bridges for nuclear density measurements and surface finishing and texturing. Use the other work bridge to apply the curing.
7. *Evaporation Control and Curing.* Control evaporation of moisture from the fresh overlay concrete and cure as specified in Subsection 504.04(e)5. Cracking or other damage caused by improper curing will be cause for rejection of the work.
8. *Ambient Temperature Limitations.* Do not place concrete when the air or deck temperature is cooler than 45°F (70°C) or the deck temperature is hotter than 85°F (30°C).

The Engineer may require placing concrete during the nighttime hours during hot weather. The Engineer will inform the Contractor, in writing, if night placing becomes necessary. Comply with floodlighting requirements of Subsection 504.04(e)3.

- (g) **Straightedge Testing and Surface Tolerance.** Immediately after completing the surface of either a repair or overlay and before final finishing, test the surface for trueness with a 10-foot (3m) straightedge. Comply with Subsection 414.04(k)4.4.

When the straightedge is laid on the repaired pavement or overlay in a direction parallel to the centerline, the surface shall not vary more than $\frac{1}{8}$ inch (3mm) from the lower edge of the straightedge. The transverse slope of the pavement shall be uniform to a degree such that no depression greater than $\frac{1}{8}$ inch (3mm) is present when tested with the 10-foot (3m) straight edge laid in a direction transverse to the centerline and extending from edge to edge in a traffic lane.

After completing curing, retest the surface and grind any high areas in excess of the specified tolerances. Groove the ground surfaces to have a texture equal to the surrounding surfaces.

- (h) **Transverse Groove Final Finish for Overlays.** Do not time finish overlays within 2 inches (50mm) of a construction joint.

1. *High Density Concrete.* After completing the finishing and before applying the transverse groove final finish, seal all vertical joints with adjacent concrete by painting with thinned grout.

After joint painting, apply the transverse groove final finish. Comply with Subsection 414.04(k)5.2, except the grooving passes shall not be overlapped but shall be within 1 inch (25mm) of the preceding pass.

2. *Latex Modified Concrete.* After completing the finishing, apply the transverse groove final finish. Comply with Subsection 414.04(k)5.2, except the grooving passes shall not be overlapped but shall be within 1 inch (25mm) of the preceding pass. This must be done before the plastic film forms on the surface, approximately 25 minutes in hot, dry weather.

Separate screed rails and construction dams from the newly placed material by passing a point trowel along their inside face. Exercise care to insure that this trowel cut is made for the entire depth and length of rails or dams after the concrete has stiffened sufficiently to not flow back.

(i) **Limitation of Operations.**

1. *Traffic Control.* During the construction period of the project, provide such traffic controls as required by the contract documents.
2. *Loading.* After removing old concrete and before placing new concrete, restrict loading on bridge decks to approved construction equipment. Limit the wheel and axle loads of construction vehicles to 8000 pounds (35kN) and 16,000 pounds (70kN) respectively. Any combination of axles spaced closer than 4 feet (1.2m) center-to-center of axles will be considered as one axle.

Unless otherwise specified, keep traffic off the finished surface during the specified curing period. Do not perform preparation work in the adjacent lane on areas adjoining new concrete during the specified curing period.

505.05. METHOD OF MEASUREMENT.

Class A bridge deck repair, Class B bridge deck repair, and Class C bridge deck repair will be computed in square yards (square meters) from measurements of the areas so repaired. All classes of bridge deck repair will be measured prior to the actual placement of the concrete.

Bridge deck overlay will be measured in square yards (square meters) from measurements of the areas so overlaid.

Authorized floodlighting will be measured and paid for as specified in Section 504 for floodlighting.

Grinding and grooving will not be measured for payment. Include the cost of these items in the cost of related items of work.

505.06. BASIS OF PAYMENT.

The accepted quantities, measured as specified in this Section, will be paid at the contract price per unit of measurement for the pay items listed below that are shown in the Plan bid schedule. Payment will be full compensation for the respective work prescribed in this Section. Payment will be made under:

- | | | |
|-----|----------------------------------|----------------------------|
| (A) | CLASS A BRIDGE DECK REPAIR | SQUARE YARD (SQUARE METER) |
| (B) | CLASS B BRIDGE DECK REPAIR | SQUARE YARD (SQUARE METER) |
| (C) | CLASS C BRIDGE DECK REPAIR | SQUARE YARD (SQUARE METER) |
| (D) | BRIDGE DECK OVERLAY | SQUARE YARD (SQUARE METER) |